

ARIZONA DEPARTMENT OF TRANSPORTATION

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EFFECTIVE COUNTERMEASURES TO REDUCE ACCIDENTS IN WORK ZONES

Final Report

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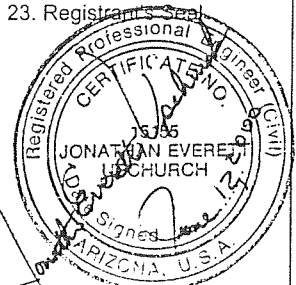
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16. Abstract <p>Nationally, work zone fatalities peaked at over 800 per year during the 1990's. Arizona tallied 82 fatal and 5,009 injury accidents in work zones during a five year period. In response to this problem, the objectives of this project included:</p> <ul style="list-style-type: none"> Characterizing the nature of work zone accidents in Arizona Reviewing countermeasures used throughout the country, and the effectiveness of those countermeasures Recommending countermeasures for use in Arizona to improve work zone safety and reduce accidents <p>Work zone accidents account for about 3 percent of all reported accidents in Arizona, or about 3,000 work zone accidents per year. These accidents produce about 18 fatalities and 1,600 injuries per year. Compared to all accidents statewide: work zone accidents tend to be less severe; larger vehicles tend to be over-represented in work zone accidents; a greater proportion of work zone accidents occur in rural areas; and work zone accidents are over-represented on the State Highway System.</p> <p>A detailed analysis of fatal accident reports did not clearly identify any common or widespread factors that contribute to fatal accidents occurring in work zones.</p> <p>A national review of work zone countermeasures was conducted, focussing on the documented effectiveness of various work zone countermeasures. To identify which countermeasures are most appropriate for use in Arizona, a panel of 21 experts was convened. The panel included representatives with a variety of perspectives on the work zone accident problem. ADOT personnel dealing with construction operations, maintenance, traffic operations, safety, and research were represented. Department of Public Safety officers, construction industry representatives, a traffic control contractor, an FHWA representative, and university researchers also attended.</p> <p>The panel selected six principal countermeasures for implementation in Arizona: 1) Work Zone Speed Limits; 2) Police Presence; 3) Speed Limit Enforcement; 4) Public Education; 5) Sign Credibility; and 6) Temporary Pavement Markings in Work Zones</p>					
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METRIC (SI*) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS				APPROXIMATE CONVERSIONS TO SI UNITS			
Symbol	When You Know	Multiply By	To Find	Symbol	When You Know	Multiply By	To Find
LENGTH				LENGTH			
in	Inches	2.54	centimeters	mm	millimeters	0.039	Inches
ft	feet	0.3048	meters	m	meters	3.28	feet
yd	yards	0.914	meters	yd	meters	1.09	yards
mi	miles	1.61	kilometers	km	kilometers	0.621	miles
AREA				AREA			
in ²	square inches	6.452	centimeters squared	mm ²	millimeters squared	0.0016	square inches
ft ²	square feet	0.0929	meters squared	m ²	meters squared	10.764	square feet
yd ²	square yards	0.836	meters squared	yd ²	kilometers squared	0.39	square miles
mi ²	square miles	2.59	kilometers squared	ha	hectares (10,000 m ²)	2.53	acres
ac	acres	0.395	hectares	MASS (weight)			
MASS (weight)				MASS (weight)			
oz	ounces	28.35	grams	g	grams	0.0353	ounces
lb	pounds	0.454	kilograms	kg	kilograms	2.205	pounds
T	short tons (2000 lb)	0.907	megagrams	Mg	megagrams (1000 kg)	1.103	short tons
VOLUME				VOLUME			
fl oz	fluid ounces	29.57	milliliters	mL	milliliters	0.034	fluid ounces
gal	gallons	3.785	liters	L	liters	0.264	gallons
ft ³	cubic feet	0.0328	meters cubed	m ³	meters cubed	35.315	cubic feet
yd ³	cubic yards	0.765	meters cubed	m ³	meters cubed	1.308	cubic yards
Note: Volumes greater than 1000 L shall be shown in m ³ .				TEMPERATURE (exact)			
TEMPERATURE (exact)				TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature
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*SI is the symbol for the International System of Measurements

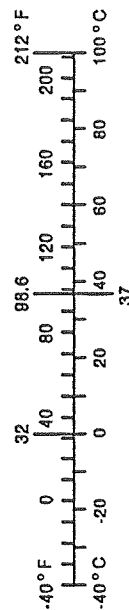


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CHAPTER 1

INTRODUCTION AND PROBLEM STATEMENT

PROBLEM STATEMENT

Work zone fatalities reached an all time high in 1994 nationwide when 833 people were killed in work zone related accidents. This represented a 29 percent increase over the 1992 level, which was the lowest recorded number of fatalities in ten years.

Work zones include sections of roadway where roadway construction, roadway maintenance, and utility work is taking place. It has been clearly demonstrated that work zones are more hazardous than the typical roadway environment. Considering exposure (such as vehicle-miles traveled), accidents are higher in work zones than on roadways in general. For that reason, work zone safety continues to be a high priority for traffic engineering professionals and highway agencies.

Work zone fatalities and injuries include not only the occupants of vehicles but also pedestrians. In many instances these "pedestrians" are workers in the work zone, either construction workers or public agency employees who are maintaining the roadway.

The following statistics summarize the extent of the problem in Arizona. This summary is for reported accidents in the 1995 calendar year.

TABLE 1: 1995 WORK ZONE ACCIDENTS IN ARIZONA

Type of Unusual Road Condition	<u>Number of Crashes</u>				<u>No. of Victims</u>	
	<u>Total</u>	<u>Fatal</u>	<u>Injury</u>	<u>PDO*</u>	<u>Killed</u>	<u>Injured</u>
Under Construction Thru Traffic Allowed	3,049	19	940	2,090	19	1,483
Under Construction Traffic Detoured	62	0	20	42	0	32
Under Repairs	129	0	51	78	0	66
Temporary Lane Closure	385	1	124	260	2	219

* PDO = Property Damage Only

It is estimated that the statewide economic loss due to the above accidents is \$70 million.

Solving work zone problems and improving work zone safety have even been emphasized in recent legislation. The Intermodal Surface Transportation Efficiency Act (ISTEA) specifically required the Secretary of Transportation to develop and implement a work zone safety program to improve safety at construction zones and to develop a uniform accident reporting system.

Currently there is significant on-going research that is studying procedures for determining work zone speed limits, establishing their effectiveness and implementability and improving traffic control device design and placement. These studies will provide additional needed knowledge to procedures for ensuring safer and more convenient work zone experiences.

Due to its importance and the amount of previous and on-going research efforts, there is a need to prepare a state-of-the-practice report to synthesize current knowledge and to formulate recommendations for reducing accidents in work zones.

OBJECTIVES OF THE PROJECT

The objectives of this project are:

- Characterize the nature of work zone accidents in Arizona.

- Prepare a state-of-the-practice report on effective countermeasures to reduce accidents in work zones.

- Recommend countermeasures which should be implemented in Arizona to improve work zone safety and to reduce accidents.

- Prepare procedures and guidelines for implementing these countermeasures.

CHAPTER 2

ANALYSIS OF WORK ZONE ACCIDENTS

The first objective of this project is to characterize the nature of work zone accidents in Arizona. To accomplish this objective, Arizona work zone accidents for calendar years 1992 through 1996 were reviewed and analyzed. The ALISS accident records system served as the source of information for this study. Through ALISS, information on **reported** accidents occurring in all jurisdictions and on all roadway networks (state, county, city) were obtained and evaluated.

In this chapter, "work zone accidents" refers to those accidents occurring in a work zone. "Statewide accidents" refers to all reported accidents throughout the state of Arizona

Accidents occurring in work zones were identified by the "unusual condition" category in the accident records database. Accident records with the following coding comprised the set of accidents that were evaluated.

- 1 - Under construction - through traffic allowed
- 2 - Under construction - traffic detoured
- 3 - Under repairs
- 11 - Temporary lane closure

ALISS includes 521,345 reported accidents for calendar years 1992 through 1996. Of these, 14,905 accidents are coded as occurring in a work zone (codes 1, 2, 3 and 11 above).

This set of 14,905 work zone accidents was sorted and summarized in a variety of ways to identify trends, patterns, circumstances and other ways of characterizing the work zone accident problem. Sorts and summaries included the following.

- By year
- Number of accidents
- By severity
- Number of fatal accidents
- Number of injury accidents
- Number of property damage only accidents
- Number of fatalities
- Number of injuries
- The type of unusual condition (1, 2, 3, 11, above)
- Whether injured and fatal individuals were vehicle occupants or pedestrians (possibly work zone workers)
- Light condition
- Weather condition
- Road surface condition
- Driver physical condition
- Vehicle type
- Collision type
- Urban vs. Rural location
- Roadway System (Interstate, State Highway System)

The work zone accident data were also compared to statewide accident data.

COMPARISON OF ARIZONA' S 5-YEAR ACCIDENTS IN WORK ZONES Vs. TOTAL STATEWIDE ACCIDENTS

Table 2 summarizes work zone accidents and statewide accidents by year. Work zone accidents have accounted for 2.86 percent of statewide accidents during the five-year period. Work zone accidents had their highest percentage of the total statewide accidents in 1995 and the lowest percentage in 1996.

TABLE 2: WORK ZONE ACCIDENTS AND STATEWIDE ACCIDENTS: 1992-1996

	WORK ZONES	STATE- WIDE	Work Zone Accidents as a % of Statewide Accidents
1992	2595	89862	2.89
1993	2844	97903	2.90
1994	2954	106728	2.77
1995	3627	113888	3.18
1996	2885	112964	2.55
5-year TOTAL	14905	521345	2.86

Tables 3 and 4 show a comparison of the injury severity between work zone and statewide accidents. Property damage only (PDO) accidents include both those with only property damage and those with unknown injury conditions.

TABLE 3: INJURY SEVERITY COMPARISON: NUMBER OF ACCIDENTS

YEAR	WORK ZONE			STATEWIDE		
	PDO	INJURY	FATAL	PDO	INJURY	FATAL
1992	1691	894	10	53137	36024	701
1993	1833	995	16	58765	38434	704
1994	1931	1001	22	64123	41809	796
1995	2470	1137	20	69248	43721	919
1996	1889	982	14	68792	43314	858
5-year TOTAL	9814	5009	82	314065	203302	3978

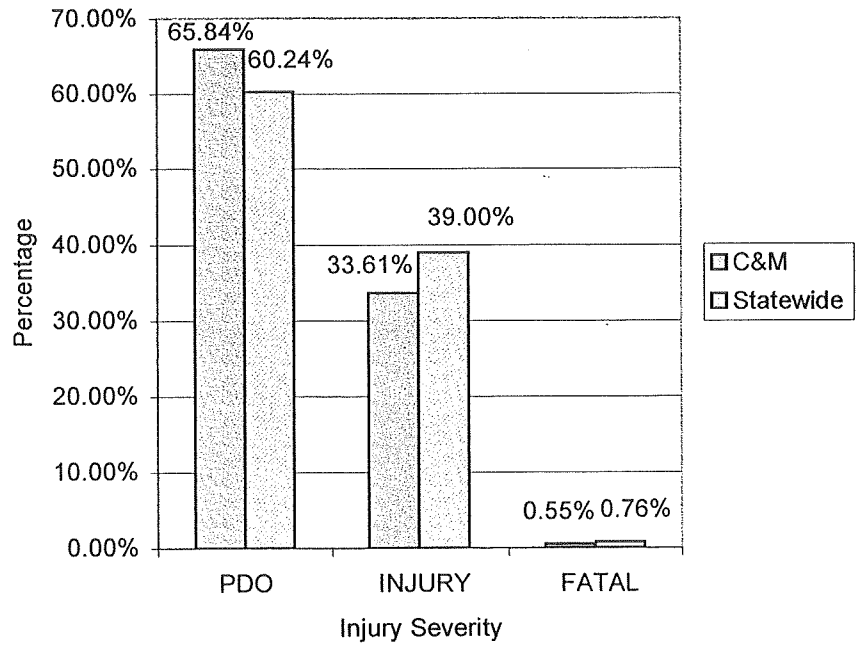
**TABLE 4: INJURY SEVERITY COMPARISON:
PERCENT OF ACCIDENTS**

YEAR	WORK ZONE			STATEWIDE		
	PDO	INJURY	FATAL	PDO	INJURY	FATAL
1992	65.16%	34.45%	0.39%	59.13%	40.09%	0.78%
1993	64.45%	34.99%	0.56%	60.02%	39.26%	0.72%
1994	65.37%	33.89%	0.74%	60.08%	39.17%	0.75%
1995	68.10%	31.35%	0.55%	60.80%	38.39%	0.81%
1996	65.48%	34.04%	0.49%	60.90%	38.34%	0.76%
5-year TOTAL	65.84%	33.61%	0.55%	60.24%	39.00%	0.76%

As indicated by the lower portion of Table 4 and as highlighted in Figure 1, accidents in work zones tended to be less severe than statewide accidents. In each year, the proportion of statewide accidents that included a fatality was larger than the proportion of work zone accidents that included a fatality. For the 5-year period as a whole, 0.76 percent of the statewide accidents had a fatality while only 0.55 percent of the work zone accidents had a fatality. Similarly, in each year the proportion of statewide accidents that included an injury was larger than the proportion of work zone accidents that included an injury. This phenomenon could be the result of lower speeds in work zones.

FIGURE 1: INJURY SEVERITY COMPARISON

As highlighted by the chart to the right, total incidents in C&M zones tended to be less severe than those statewide (0.55% vs 0.76% fatalities and 65.84% vs 60.24% PDO).



The evidence that work zone accidents are less severe is further supported by Table 5 on the following page which breaks down each year by injury severity category. The key for Injury Severity Type is presented following the table. The table is also subdivided by Road Condition.

**TABLE 5: NUMBER OF ACCIDENTS BY YEAR,
ROAD CONDITION, AND INJURY SEVERITY TYPE**

YEAR	ROAD CONDITION	INJURY SEVERITY TYPE						ROAD COND TOTAL
		1	6	2	3	4	5	
1992	1	1367	27	392	234	123	9	2152
	2	20	2	3	6	2	0	33
	3	67	2	15	11	4	1	100
	11	200	6	57	32	15	0	310
TOTAL 1992 WORK ZONE BY SEVERITY		1654	37	467	283	144	10	2595
% OF 1992 WORK ZONE ACCIDENTS		65.16%		34.45%			0.39%	100.00%
% OF 1992 TOTAL ACCIDENTS		59.13%		40.09%			0.78%	100.00%
1993	1	1434	29	440	217	154	12	2286
	2	36	5	10	1	0	2	54
	3	88	0	21	10	4	1	124
	11	236	5	76	50	12	1	380
TOTAL 1993 WORK ZONE BY SEVERITY		1794	39	547	278	170	16	2844
% OF 1993 WORK ZONE ACCIDENTS		64.45%		34.99%			0.56%	100.00%
% OF 1993 TOTAL ACCIDENTS		60.02%		39.26%			0.72%	100.00%
1994	1	1575	28	456	246	117	21	2443
	2	36	1	12	2	6	0	57
	3	75	2	20	12	3	1	113
	11	214	0	77	37	13	0	341
TOTAL 1994 WORK ZONE BY SEVERITY		1900	31	565	297	139	22	2954
% OF 1994 WORK ZONE ACCIDENTS		65.37%		33.89%			0.74%	100.00%
% OF 1994 TOTAL ACCIDENTS		60.08%		39.17%			0.75%	100.00%
1995	1	2052	38	550	293	97	19	3049
	2	38	4	6	11	3	0	62
	3	77	1	27	18	8	0	131
	11	258	2	63	45	16	1	385
TOTAL 1995 WORK ZONE BY SEVERITY		2425	45	646	367	124	20	3627
% OF 1995 WORK ZONE ACCIDENTS		68.10%		31.35%			0.55%	100.00%
% OF 1995 TOTAL ACCIDENTS		60.80%		38.39%			0.81%	100.00%

YEAR	ROAD CONDITION	INJURY SEVERITY TYPE						ROAD COND TOTAL
		1	6	2	3	4	5	
1996	1	1534	33	445	240	104	9	2365
	2	25	2	8	6	4	1	46
	3	51	3	30	9	3	1	97
	11	237	4	79	44	10	3	377
TOTAL 1996 WORK ZONE BY SEVERITY		1847	42	562	299	121	14	2885
% OF 1996 WORK ZONE ACCIDENTS		65.48%		34.04%			0.49%	100.00%
% OF 1996 TOTAL ACCIDENTS		60.90%		38.34%			0.76%	100.00%

ROAD CONDITION CODES:

- 1 = Under Construction, Traffic Allowed
- 2 = Under Construction, Traffic Not Allowed
- 3 = Under Repairs
- 11 = Temporary Lane Closure

SEVERITY TYPE CODES:

- 1 = No Injury
- 2 = Possible Injury
- 3 = Non-Incapacitating Injury
- 4 = Incapacitating Injury
- 5 = Fatal
- 6 = Unknown

Note:

- Type 1 plus Type 6 corresponds to the PDO category in Tables 3 and 4.
- Type 2 plus Type 3 plus Type 4 corresponds to the injury category in Tables 3 and 4
- Type 5 corresponds to the fatal category in Tables 3 and 4.
- Additional information on the number of persons injured or killed is presented in Table 6.

Additional information on the number of persons injured or killed is presented in Table 6. (All preceding tables have been comparisons of number of accidents.)

TABLE 6: NUMBER OF PERSONS INJURED OR KILLED

YEAR	WORK ZONES		STATEWIDE	
	INJURED	KILLED	INJURED	KILLED
1992	1387	10	58496	809
1993	1580	18	63037	801
1994	1590	26	68872	906
1995	1802	21	71994	1037
1996	1629	14	71807	995
Five Year TOTAL	7988	89	334206	4548

Table 7 presents an injury severity comparison of the total number of people injured and killed, the percent who were injured, and the percent who were killed.

TABLE 7: INJURY SEVERITY COMPARISON

YEAR	WORK ZONES		STATEWIDE	
	INJURED	KILLED	INJURED	FATAL
1992	99.28%	0.72%	98.64%	1.36%
1993	98.87%	1.13%	98.75%	1.25%
1994	98.39%	1.61%	98.70%	1.30%
1995	98.85%	1.15%	98.58%	1.42%
1996	99.15%	0.85%	98.63%	1.37%
Five Year TOTAL	98.90%	1.10%	98.66%	1.34%

Overall, if involved in an accident producing injuries or fatalities, the chances of being a fatality are slightly smaller if the accident occurred in a work zone. For example, 1.34 percent of the victims in statewide accidents (1992 through 1996) were killed while 1.10 percent of the victims in work zone accidents were killed. This phenomenon occurred in each year except 1994. The phenomenon could be the result of lower speeds in work zones.

The numbers of injuries and fatalities were further compared by road condition. Work zone accidents were identified from the accident data provided by four road condition codes: (1) under construction, traffic allowed; (2) under construction, traffic not allowed; (3) under repairs; and (11) temporary lane closure. As shown in Tables 8 and 9, the proportion between number of persons injured and number of fatalities is nearly identical for accidents occurring in work zones and those occurring statewide.

TABLE 8: NUMBER OF INJURIES/FATALITIES BY ROAD CONDITION

ROAD CONDITION	INJURY	FATAL	TOTAL
1	6526	75	6601
2	114	4	118
3	293	4	297
11	1055	6	1061
5-YR WORK ZONE TOTAL	7988	89	8077
5-YR STATEWIDE TOTAL	334206	4548	338754

TABLE 9: PERCENT OF INJURIES/FATALITIES BY ROAD CONDITION

ROAD CONDITION	INJURY	FATAL	TOTAL
1	98.86%	1.14%	100.00%
2	96.61%	3.39%	100.00%
3	98.65%	1.35%	100.00%
11	99.43%	0.57%	100.00%
5-YR WORK ZONE TOTAL	98.90%	1.10%	100.00%
5-YR STATEWIDE TOTAL	98.66%	1.34%	100.00%

ROAD CONDITION CODES:

- 1 = Under Construction, Traffic Allowed
- 2 = Under Construction, Traffic Not Allowed
- 3 = Under Repairs
- 11 = Temporary Lane Closure

There were 14,905 accidents that occurred in work zones in 1992 – 1996. A total of 44,224 individuals were involved in these accidents. The 14,905 accidents had a total of 89 fatalities and 7988 injuries. Others who were involved in these accidents were not injured. These included 22,666 drivers, 12,190 passengers, 6 pedestrians, and 12 pedalcyclists. In addition, 1,273 individuals were involved but their injury severity is unknown. Data on injury severity by person type for work zone accidents is presented in Tables 10-12. Comparable data for statewide accidents during the five year period is not available. However, the data for the work zones is presented for consideration.

TABLE 10: NUMBER OF INJURIES BY PERSON TYPE AND INJURY SEVERITY TYPE

PERSON TYPE	INJURY SEVERITY TYPE						PERS TYPE
	1	2	3	4	5	6	TOTAL
1 - Driver	22666	3018	1408	606	57	1112	28867
2 - Pedestrian	6	35	50	34	13	0	138
3 - Pedalcyclist	12	25	36	18	1	0	92
4 - Passenger	12190	1655	806	297	18	161	15127
5-YR TOTAL BY SEVERITY TYPE	34874	4733	2300	955	89	1273	44224
	34874	7988			89	1273	

TABLE 11: PERCENT OF INJURIES BY INJURY SEVERITY TYPE

PERSON TYPE	INJURY SEVERITY TYPE						SEVERITY TYPE
	1	2	3	4	5	6	TOTAL
1 - Driver	78.52%	10.45%	4.88%	2.10%	0.20%	3.85%	100.00%
2 - Pedestrian	4.35%	25.36%	36.23%	24.64%	9.42%	0.00%	100.00%
3 - Pedalcyclist	13.04%	27.17%	39.13%	19.57%	1.09%	0.00%	100.00%
4 - Passenger	80.58%	10.94%	5.33%	1.96%	0.12%	1.06%	100.00%
% BY SEVERITY TYPE	78.86%	10.70%	5.20%	2.16%	0.20%	2.88%	100.00%

TABLE 12: PERCENT OF INJURIES BY PERSON TYPE

PERSON TYPE	INJURY SEVERITY TYPE						% BY PERS TYPE
	1	2	3	4	5	6	
1 - Driver	64.99%	63.77%	61.22%	63.46%	64.04%	87.35%	65.27%
2 - Pedestrian	0.02%	0.74%	2.17%	3.56%	14.61%	0.00%	0.31%
3 - Pedalcyclist	0.03%	0.53%	1.57%	1.88%	1.12%	0.00%	0.21%
4 - Passenger	34.95%	34.97%	35.04%	31.10%	20.22%	12.65%	34.21%
SEVERITY TYPE TOTAL	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

INJURY SEVERITY TYPE CODES:

1 = No Injury 4 = Incapacitating Injury
 2 = Possible Injury 5 = Fatal
 3 = Non-Incapacitating Injury 6 = Unknown

Data was available to allow comparison between pedestrians injured or killed in work zone accidents and accidents statewide. Of all people killed in work zone accidents, 14.61 percent were pedestrians. In comparison, of all people killed in statewide accidents, 15.96 percent were pedestrians. Similar information is presented for injuries. This data is shown in Table 13.

TABLE 13: PERCENT OF INJURIES AND FATALITIES INVOLVING PEDESTRIANS

	INJURED	KILLED
5-YR WORK ZONE ACCIDENTS	1.49%	14.61%
5-YR TOTAL ACCIDENTS	2.31%	15.96%

The Table 13 data shows that the proportion of injuries and fatalities in work zones involving pedestrians is slightly lower than the proportion of injuries and fatalities involving pedestrians in accidents statewide. The data indicate that work zones are not more hazardous to pedestrians than other roadways. The available data did not indicate how many of the pedestrians injured were workers in the work zone. Review of fatal accident reports (described later) identified two workers who were killed in accidents. Both of these fatalities involved construction vehicles.

Further comparisons were done between various conditions in work zone accidents and accidents statewide. The results are shown in Tables 14 and 15.

TABLE 14: NUMBER OF ACCIDENTS BY ROAD CONDITION AND LIGHT

ROAD CONDITION	LIGHT TYPE				ROAD COND TOTAL
	0	1	2	3	
1	0	9055	443	2797	12295
2	0	135	14	103	252
3	0	450	10	105	565
11	0	1379	42	372	1793
5-YR WORK ZONE LIGHT TOTAL	0	11019	509	3377	14905
5-YR STATE-WIDE TOTAL	1017	373222	23076	124030	521345

TABLE 15: PERCENT OF ACCIDENTS BY ROAD CONDITION AND LIGHT

ROAD CONDITION	LIGHT TYPE				ROAD COND TOTAL
	0	1	2	3	
1	0.00 %	73.65%	3.60%	22.75%	100.00%
2	0.00 %	53.57%	5.56%	40.87%	100.00%
3	0.00 %	79.65%	1.77%	18.58%	100.00%
11	0.00	76.91%	2.34%	20.75%	100.00%
5-YR WORK ZONE LIGHT TOTAL	0.00 %	73.93%	3.41%	22.66%	100.00%
5-YR STATEWIDE TOTAL	0.20 %	71.59%	4.43%	23.79%	100.00%

ROAD CONDITION CODES:

- 1 = Under Construction, Traffic Allowed
- 2 = Under Construction, Traffic Not Allowed
- 3 = Under Repairs
- 11 = Temporary Lane Closure

LIGHT TYPE CODES:

- 0 = Not Reported
- 1 = Daylight
- 2 = Dawn or Dusk
- 3 = Darkness

It could be hypothesized that nighttime accidents in work zones would occur more frequently than on normal roadways. This could occur if signing, marking and delineation treatments for the temporary conditions did not adequately guide the motorist in darkness. The accident data do not support this hypothesis. The comparison of lighting conditions shows that the proportion of work zone accidents occurring during darkness is slightly lower than for statewide accidents.

The proportion of work zone accidents occurring during daylight is slightly higher than for statewide accidents. These results could be due to the majority of work zone activities occurring during daylight conditions. However, it could also be an indication that work zones are adequately marked and lighted for non-daylight conditions.

It could be hypothesized that accidents during inclement weather in work zones would occur more frequently than on normal roadways. Comparison of weather conditions shows that the proportion of work zone accidents occurring during raining and snowing conditions is much smaller than that occurring statewide (see Tables 16 and 17). This effect could be due to less work zone activities occurring during these weather conditions. Also, a slightly higher proportion of work zone accidents occurs during strong wind as compared to statewide accidents. This could be the result of traffic control devices having been blown down or motorists distracted by the windy conditions and not being fully aware of the conditions in the work zone.

TABLE 16: NUMBER OF ACCIDENTS BY ROAD CONDITION AND WEATHER CONDITION

ROAD CONDITION	WEATHER CONDITION							ROAD COND TOTAL
	0	1	2	3	4	5	6	7
1	31	10530	404	1255	6	58	6	5
2	1	212	9	29	0	1	0	0
3	1	471	14	73	0	4	2	0
11	2	1488	82	205	6	9	0	1
5-YR WORK ZONE WEATHER TOTAL	35	12701	509	1562	12	72	8	6
5-YR STATE-WIDE WEATHER TOTAL	2286	432153	27169	53375	3819	2030	193	320
								521345

TABLE 17: PERCENT OF ACCIDENTS BY ROAD CONDITION AND WEATHER CONDITION

ROAD CONDITION	WEATHER CONDITION							ROAD COND TOTAL
	0	1	2	3	4	5	6	7
1	0.25%	85.64%	3.29%	10.21%	0.05%	0.47%	0.05%	0.04%
2	0.40%	84.13%	3.57%	11.51%	0.00%	0.40%	0.00%	0.00%
3	0.18%	83.36%	2.48%	12.92%	0.00%	0.71%	0.35%	0.00%
11	0.11%	82.99%	4.57%	11.43%	0.33%	0.50%	0.00%	0.06%
5-YR WORK ZONE WEATHER TOTAL	0.23%	85.21%	3.41%	10.48%	0.08%	0.48%	0.05%	0.04%
5-YR STATEWIDE WEATHER TOTAL	0.44%	82.89%	5.21%	10.24%	0.73%	0.39%	0.04%	0.06%
								100.00%

ROAD CONDITION CODES:

- 1 = Under Construction, Traffic Allowed
- 2 = Under Construction, Traffic Not Allowed
- 3 = Under Repairs
- 11 = Temporary Lane Closure

WEATHER CONDITION CODES:

- 0 = Not Reported
- 1 = Clear
- 2 = Raining
- 3 = Cloudy
- 4 = Snowing
- 5 = Strong Wind
- 6 = Dust
- 7 = Fog

Table 18 compares road surface conditions and breaks down the data by accident severity. The accidents in work zones tend to be less severe than accidents statewide as previously shown. The last column in the table reveals that the “other” surface condition is much more common in work zone accidents. The “other” surface condition includes loose sand, dirt, or gravel surfaces such as are commonly found in work-zones, so it is not surprising that this surface condition is reported more commonly for work-zone accidents. Even when the “other” surface condition is ignored, it is still less likely that work zone accidents would occur during “wet” or “snowy/icy” conditions. This effect is probably because construction and maintenance activities are less likely during wet, snowy, and icy weather.

**TABLE 18: COMPARISON OF ROAD SURFACE CONDITIONS FOR
WORK ZONE ACCIDENTS vs. TOTAL STATEWIDE ACCIDENTS**

	SURFACE	PDO		INJURY		FATAL		TOTAL	
		#	%	#	%	#	%	#	%
5-YR WORK ZONE	Dry	8119	54.47%	4214	28.27%	74	0.50%	12407	83.24%
	Wet	503	3.37%	251	1.68%	2	0.01%	756	5.07%
	Snowy/Icy	35	0.23%	7	0.05%	0	0.00%	42	0.28%
	Other	1157	7.76%	537	3.60%	6	0.04%	1700	11.41%
	TOTAL	9814	65.84%	5009	33.61%	82	0.55%	14905	100.00%
5-YR STATE- WIDE	Dry	280522	53.80%	184698	35.42%	3638	0.70%	468858	89.92%
	Wet	22321	4.28%	13598	2.61%	182	0.03%	36101	6.92%
	Snowy/Icy	4827	0.93%	1541	0.30%	39	0.01%	6407	1.23%
	Other	6485	1.24%	3465	0.66%	118	0.02%	10068	1.93%
	TOTAL	314155	60.25%	203302	38.99%	3977	0.76%	521434	100.00%

As shown in Table 19, drivers involved in work zone accidents generally have fewer detrimental physical conditions than accidents statewide with the exception of categories #4-ill-ability influenced and category #6 - other bodily defects/infirmities. The category of DUI is not more prevalent in work zone accidents than total statewide accidents.

**TABLE 19: COMPARISON OF DRIVER PHYSICAL CONDITION:
WORK ZONE ACCIDENTS vs STATEWIDE ACCIDENTS**

PHYSICAL CONDITION	5-YR WORK ZONE		5-YR STATEWIDE	
	# DRIVERS	%	# DRIVERS	%
0-not reported	2017	6.93%	74067	7.59%
1-no apparent defects	25722	88.40%	848360	86.97%
2-had been drinking	1036	3.56%	39277	4.03%
3-appeared under influence of drugs	0	0.00%	1416	0.15%
4-ill-ability influenced	59	0.20%	1461	0.15%
5-sleepy/fatigued	31	0.11%	8339	0.85%
6-other bodily defects/infirmities	206	0.71%	2580	0.26%
7-unknown	27	0.09%		0.00%
TOTAL	29098	100.00%	975500	100.00%

The vehicle-type proportions between accidents occurring in work zones and those occurring statewide are similar for most vehicle types. Generally, larger vehicles tend to be over-represented in work zone accidents (see Table 20). For some vehicle categories the number of vehicles is small or the difference is not statistically significant. The vehicle types that are most obviously over-represented are: "truck tractor and semi-trailer" and "other truck combination." Other over-represented vehicle types are: "pickup truck," "pickup truck with camper," "motor home," and "emergency vehicle."

It is possible that some of the trucks involved in accidents are construction vehicles. However, this could be determined only by reviewing individual accident report forms. The over-representation of larger vehicles suggests that these vehicles may have more difficulty coping with the unusual conditions existing in work zones. It may also suggest that targeting enforcement of these vehicles would be effective.

TABLE 20: MOTOR VEHICLE ACCIDENT INVOLVEMENT BY VEHICLE TYPE

MOTOR VEHICLE TYPE	5-YR WORK ZONE		5-YR STATEWIDE	
	#	%	#	%
0-not reported	327	1.13%	14178	1.45%
1/2/3-passenger car	17849	61.83%	640537	65.69%
passenger car & trailer	0	0.00%	1270	0.13%
4-pickup truck (inc. panel & mini bus)	7772	26.92%	252706	25.92%
5-pickup with camper	176	0.61%	4561	0.47%
6-other vehicle with camper	2	0.01%	53	0.01%
7-truck tractor & semi-trailer	866	3.00%	13436	1.38%
8-truck tractor only	22	0.08%	541	0.06%
9-farm tractor or other farm vehicle	16	0.06%	178	0.02%
10-taxicab	18	0.06%	658	0.07%
11/12-bus	81	0.28%	2643	0.27%
13/14-school bus	39	0.14%	1271	0.13%
15-motorcycle (2 or 3-wheel)	339	1.17%	10826	1.11%
16-motorscooter or motor bicycle	0	0.00%	49	0.01%
17-RV (all-wheel drive, dune buggy, jalopy, custom)	440	1.52%	15356	1.57%
18-motor home or house car	108	0.37%	1838	0.19%
19-military	0	0.00%	13	0.00%
20-special controls	8	0.03%	93	0.01%
21-emergency vehicle	43	0.15%	649	0.07%
22-other truck combination	708	2.45%	13239	1.36%
23-other vehicle	53	0.18%	957	0.10%
24-moped	1	0.00%	39	0.00%
TOTAL	28868	100.00%	975091	100.00%

Tables 21 and 22 compare accidents by road condition and collision type. A higher proportion of accidents in work zones involve sideswipe (same direction) and rear-end collisions than accidents statewide. Work zones often route traffic on temporary alignments involving more severe curvature and less delineation. These factors may account for more sideswipe accidents. Rear-end collisions are often the result of congested or stop-and-go traffic. These conditions often occur in work zones due to reduction in capacity. A lower proportion of angle and left turn collisions occur in work zones than accidents statewide. Single-vehicle accidents are slightly lower in work zones than accidents statewide.

Collision Type 7 – Backing – occurred in 245 accidents. It would be interesting to know how many of these collisions involved public vehicles and how many involved construction vehicles. This information could be obtained only by reviewing individual accident report forms.

TABLE 21: NUMBER OF ACCIDENTS BY ROAD CONDITION AND COLLISION TYPE

	COLLISION TYPE													ROAD COND TOTAL
	0	1	2	3	4	5	6	7	8	A	B	C	D	
ROAD CONDITION														
1	2489	1646	119	1350	850	5036	71	176	404	0	1	16	137	12295
2	147	16	2	16	8	33	1	17	7	0	0	1	4	252
3	167	64	3	69	34	178	4	17	18	0	0	1	10	565
11	219	323	10	129	98	910	6	35	35	0	0	2	26	1793
5-YR WORK ZONE COLLISIONS	3022	2049	134	1564	990	6157	82	245	464	0	1	20	177	14905

TABLE 22: PERCENT OF ACCIDENTS BY ROAD CONDITION AND COLLISION TYPE

ROAD CONDITION	COLLISION TYPE													ROAD COND TOTAL
	0	1	2	3	4	5	6	7	8	A	B	C	D	
1	20.24%	13.39%	0.97%	10.98%	6.91%	40.96%	0.58%	1.43%	3.29%	0.00%	0.01%	0.13%	1.11%	100.00%
2	58.33%	6.35%	0.79%	6.35%	3.17%	13.10%	0.40%	6.75%	2.78%	0.00%	0.00%	0.40%	1.59%	100.00%
3	29.56%	11.33%	0.53%	12.21%	6.02%	31.50%	0.71%	3.01%	3.19%	0.00%	0.00%	0.18%	1.77%	100.00%
11	12.21%	18.01%	0.56%	7.19%	5.47%	50.75%	0.33%	1.95%	1.95%	0.00%	0.00%	0.11%	1.45%	100.00%
5-YR WORK ZONE COLLISIONS	20.28%	13.75%	0.90%	10.49%	6.64%	41.31%	0.55%	1.64%	3.11%	0.00%	0.01%	0.13%	1.19%	100.00%
3-YR STATEWIDE COLLISIONS*	23.22%	9.03%	0.92%	18.40%	10.15%	32.11%	0.59%	1.56%	4.00%	N/A	N/A	N/A	N/A	99.98%

*data not available for 1993 & 1994

ROAD CONDITION

CODES :

- 1 = Under Construction, Traffic Allowed
- 2 = Under Construction, Traffic Not Allowed
- 3 = Under Repairs
- 11 = Temporary Lane Closure

COLLISION TYPE:

- 0 = Single Vehicle
- 1 = Sideswipe (Same Direction)
- 2 = Sideswipe (Opposite Direction)
- 3= Angle
- 4 = Left Turn
- 5 = Rear End
- 7 = Backing
- 8= Other
- A = Driveway/Alley Related
- B = Non-Contact (Motorcycle)
- C = Non-Contact (Non-Motorcycle)
- D = U-turn

TABLE 23: COMPARISON OF WORK ZONE ACCIDENTS VS. STATEWIDE ACCIDENTS

YEAR	SURFACE	PDO		INJURY		FATAL		TOTAL	
		#	%	#	%	#	%	#	%
5-YR WORK ZONE	Urban	7297	48.96%	3793	25.45%	40	0.27%	11130	74.67%
	Rural	2517	16.89%	1216	8.16%	42	0.28%	3775	25.33%
	TOTAL	9814	65.84%	5009	33.61%	82	0.55%	14905	100.00%
5-YR STATE WIDE TOTAL	Urban	249351	47.83%	166252	31.89%	1776	0.34%	417379	80.06%
	Rural	64714	12.41%	37050	7.11%	2202	0.42%	103966	19.94%
	TOTAL	314065	60.24%	203302	39.00%	3978	0.76%	521345	100.00%

The Table 23 comparison shows once again that work zone accidents tend to be less severe than those statewide; however, there is a difference between urban and rural accidents. Of total accidents statewide, 19.94% occur in rural areas; whereas, 25.33% of all work zone accidents occur in rural areas. This is graphically shown in Figure 2.

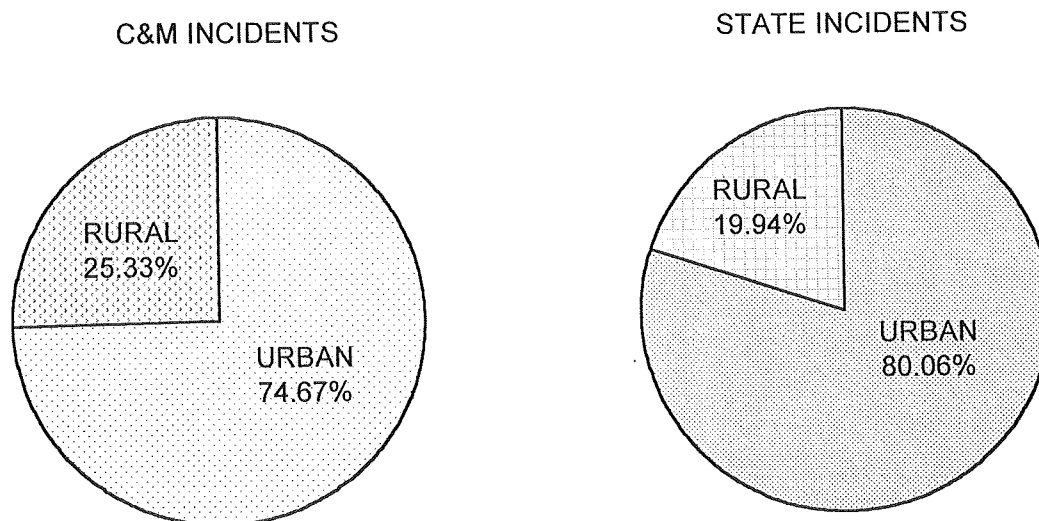
FIGURE 2: COMPARISON OF C&M Vs STATEWIDE URBAN AND RURAL ACCIDENTS

Table 24 is a comparison of work zone accidents on the State Highway System. The State Highway System is comprised of (1) Interstate Highways; and 2) other roadways on the State Highway System. Of the 14,905 work zone accidents occurring in 1992-1996, 5,320 occurred on the State Highway System. Of the 5,320 accidents, 3,095 occurred on the Interstate and 2,225 occurred on other roadways on the State Highway System.

**TABLE 24: COMPARISON OF INTERSTATE vs.
OTHER STATE HIGHWAY URBAN AND RURAL ACCIDENTS**

YEAR	SURFACE	PDO		INJURY		FATAL		TOTAL	
		#	%	#	%	#	%	#	%
5-YR INTER- STATE	Urban	1331	43.00	537	17.35	9	0.29	1877	60.65
	Rural	864	27.92	343	11.08	11	0.36	1218	39.35
	TOTAL	2195	70.92	880	28.43	20	0.65	3095	100.00
5-YR OTHER STATE HWY	Urban	575	25.84	316	14.20	3	0.13	894	40.18
	Rural	851	38.25	464	20.85	16	0.72	1331	59.82
	TOTAL	1426	64.09	780	35.06	19	0.85	2225	100.00

This comparison shows that there is a difference in severity between the Interstate system and other state highways. Interstate accidents tend to be less severe; a smaller portion of Interstate accidents involve injuries or fatalities. This finding is consistent with past experience showing that the roadway design of Interstate facilities results in a lower fatality rate. A majority of Interstate accidents occur within the urban environment. In contrast, accidents on other state highways were more severe and occurred more often in the rural environment.

Table 25 compares work zone accidents on the State Highway System and total statewide accidents. Analysis showed that approximately 19.27% of all accidents statewide occur on the State Highway System. In contrast, 35.7% of all work zone accidents occur on the State Highway System. Overall, the proportion of work zone accidents occurring on the State Highway System divided by the proportion of all accidents occurring on the State Highway System is 1.85. This is very strong evidence that work zone accidents are over-represented on the State Highway System.

One possible reason for this over-representation could be due to more work zone activities occurring on the State Highway System than on other roadways since heavier pavement loadings on state roadways require more frequent construction and/or maintenance. Unfortunately, information on the relative amount of work zone activity on the State Highway System is not readily available. Another reason could be that cities and counties are doing a better job of traffic control. The apparent disproportion of work zone accidents on the State Highway System could be a phenomenon of accident reporting. The Department of Public Safety (which patrols the State Highway System) may do a better job of reporting than do local police agencies (which patrol other roadways). In addition, ADOT's work zones may be more "visible" or more likely to be noted as an "unusual condition." It was noted earlier in this report that larger vehicles are over-represented in work zone accidents. Large trucks travel much more on the State Highway System than on other roadways and may therefore contribute to the disproportion of work zone accidents on the State Highway System.

**TABLE 25: COMPARISON OF WORK ZONE ACCIDENTS ON STATE HIGHWAY SYSTEM
Vs. STATEWIDE ACCIDENTS ON STATE HIGHWAY SYSTEM**

YEAR	PDO			INJURY			FATAL			TOTAL		
	# STATE	# TOTAL	%	# STATE	# TOTAL	%	# STATE	# TOTAL	%	# STATE	# TOTAL	%
1992 WORK ZONE	613	1691	36.25%	292	894	32.66%	8	10	80.00%	913	2595	35.18%
1992 TOTAL	11687	53137	21.99%	6065	36024	16.84%	280	701	39.94%	18032	89862	20.07%
1993 WORK ZONE	653	1833	35.62%	336	995	33.77%	5	16	31.25%	994	2844	34.95%
1993 TOTAL	12453	58765	21.19%	6450	38434	16.78%	271	704	38.49%	19174	97903	19.58%
1994 WORK ZONE	648	1931	33.56%	314	1001	31.37%	9	22	40.91%	971	2954	32.87%
1994 TOTAL	13160	64123	20.52%	6562	41809	15.70%	320	796	40.20%	20042	106728	18.78%
1995 WORK ZONE	1063	2470	43.04%	436	1137	38.35%	10	20	50.00%	1509	3627	41.60%
1995 TOTAL	14380	69248	20.77%	6957	43721	15.91%	323	919	35.15%	21660	113888	19.02%
1996 WORK ZONE	644	1889	34.09%	282	982	28.72%	7	14	50.00%	933	2885	32.34%
1996 TOTAL	14216	68792	20.67%	6981	43314	16.12%	346	858	40.33%	21543	112964	19.07%
5-YR WORK ZONE	3621	9814	36.90%	1660	5009	33.14%	39	82	47.56%	5320	14905	35.69%
5-YR TOTAL	65896	314065	20.98%	33015	203302	16.24%	1540	3978	38.71%	100451	521345	19.27%
RATIO*	1.76			2.04			1.23			1.85		

*Ratio: Proportion of work zone accidents occurring on State Highway System divided by proportion of all accidents occurring on the State Highway System.
Columns labeled "# STATE" refer to numbers of accidents on the State Highway System
Columns labeled "# TOTAL" refer to numbers of accidents statewide.
Rows labeled "WORK ZONE" refer to accidents in work zones.
Rows labeled "TOTAL" refer to all reported accidents statewide.

SUMMARY OF FINDINGS – WORK ZONE ACCIDENT ANALYSIS

Work zone accidents account for about 3 percent of all reported accidents in Arizona. About 3,000 work zone accidents per year occur in Arizona. These accidents produce about 18 fatalities and 1,600 injuries each year.

In general, the characteristics of work zone accidents are very similar to statewide accidents. The proportion of injuries and fatalities in work zones that involve pedestrians is no higher than the proportion of injuries and fatalities involving pedestrians statewide. Driving under the influence of alcohol is not more prevalent in work zone accidents than in statewide accidents. Areas in which work zone accidents are different include the following:

- Work zone accidents tend to be less severe than statewide accidents.
- Comparing work zone accidents with statewide accidents, a slightly smaller proportion of work zone accidents occur at night.
- Comparing work zone accidents with statewide accidents, a much smaller proportion of work zone accidents occur during inclement weather conditions, or when the pavement is wet, snowy, or icy.
- Work zone accidents are much more likely (than statewide accidents) to have unusual road surface conditions such as loose sand, dirt, or gravel surfaces.
- Generally, larger vehicles tend to be over-represented in work zone accidents compared to statewide accidents.
- Sideswipe (same direction) and rear-end collisions occur more commonly in work zone accidents than in statewide accidents.
- Angle and left turn collisions occur less commonly in work zone accidents than in statewide accidents.
- Compared to statewide accidents, a greater proportion of work zone accidents occur in rural areas.
- Work zone accidents on the Interstate System tend to be less severe than work zone accidents on the remainder of the State Highway System.
- Work zone accidents are over-represented on the State Highway System.

The available data indicated that two work zone workers were killed in accidents. The number of workers injured was not available in the data which was reviewed.

FATAL ACCIDENT ANALYSIS

To further characterize the nature of work zone accidents, this research project included a more detailed analysis of fatal accidents. Although most of the information appearing on an accident report form is coded into ALISS, other portions of the accident report do not lend themselves to digital coding. These portions include the narrative reports of all presiding officers, their description of the scene, and their diagrams of the accident, as well as the reports of all witnesses. Microfiche copies of the accident report forms for the 82 fatal work zone accidents occurring in 1992 through 1996 were reviewed to determine what additional information could be found which was not apparent by the coding required for entry into the accident data base. This review sought any qualitative information which could be pertinent to the accident occurring in the work zone. The information obtained by this review is shown in Table 26.

TABLE 26: TABULATION OF FATAL ACCIDENTS

year	accident time	1st harmful	officer opinion	other notation	# units	# injurd	# fatal
1992	15:45	16	driver inexperience	no shoulder striping	2	2	1
1992	11:30	16	excessive speed	obstruction by flashing device	2	1	1
1992	16:45	16	medical incapacity		2	1	1
1992	19:45	14	pedestrian crossing road	low illumination	2	0	1
1992	1:09	1	DUI		1	0	1
1992	23:40	16	speed, inattention		2	1	1
1992	21:15	1	speed, DUI	no shoulder striping	1	0	1
1992	6:00	41	faulty brakes (semi)		1	0	1
1992	16:00	1	speed		1	0	1
1992	11:15	16	speed, driver error		2	0	1
1993	11:10	14	pedestrian crossing road		2	0	1
1993	17:00	14	unknown		3	1	1
1993	5:45	41	ran off road		1	0	1
1993	0:13	37	passed road closed signs		1	2	1
1993	22:40	16	speed, DUI	no striping	2	2	2
1993	19:45	37	medical incapacity/DUI		1	0	1
1993	8:14	14		flagman run over by dump truck	2	0	1
1993	11:56	16	speed		3	2	1
1993	15:01	14	pedestrian crossing road		2	0	1
1993	2:37	37	speed, fleeing prior accident		1	0	2
1993	10:00	1	ran off road	no striping	1	0	1
1993	10:22	16	ignored no left turn signs		2	0	1
1993	12:15	1	speed, improper towing		2	1	1
1993	19:20	14	pedestrian crossing road		2	0	1
1993	18:45	14	pedestrian crossing road	no crosswalk striping	2	0	1
1993	13:55	1	speed, DUI	no shoulder striping	1	0	1
1994	15:08	13	motorcycle; evasive action		1	0	1

year	accident time	1st harmful	officer opinion	other notation	# units	# injurd	# fatal
1994	22:49	14	unknown, hit & run		2	0	1
1994	5:15	13	ran off road		1	0	1
1994	21:46	16	speed, DUI		2	1	1
1994	8:55	14		officer run over by construction semi	2	0	1
1994	20:19	14	pedestrian crossing road		2	0	1
1994	11:55	16	motorcycle; evasive action		2	0	1
1994	6:30	1	ran off road	no striping; uneven pavement	1	0	1
1994	19:40	14	DUI, pedestrian, hit & run	no striping (temporary tabs)	2	0	1
1994	16:57	16	DUI		2	2	1
1994	2:35	20	DUI, train/car		1	0	1
1994	10:29	16	faulty brakes		8	8	1
1994	15:00	41	unknown		1	3	1
1994	6:09	16	speed	no striping	2	1	2
1994	16:45	16	left turn on red		2	2	1
1994	23:15	27	speed, DUI	no striping	1	1	1
1994	15:00	16	DUI		2	2	3
1994	10:02	1	speed	no striping (temporary tabs)	1	2	1
1994	7:17	16	sleep		2	2	1
1994	20:30	16	unknown		2	1	2
1994	2:05	34	speed, DUI		1	1	1
1994	7:48	17	loss of control		2	2	1
1995	8:41	18	sleep		1	1	1
1995	2:30	1	DUI		1	2	1
1995	4:39	16	DUI		2	0	2
1995	6:00	16	speed, illegal passing		2	1	1
1995	17:10	50	faulty equipment		2	0	1
1995	22:38	16	medical incapacity		4	3	1
1995	2:53	26	speed, collision with animal	no striping	1	0	1
1995	7:05	16	speed, DUI	no striping (temporary tabs)	2	1	1
1995	8:30	16	ran red light, medical incapacity		3	2	1
1995	0:10	16	speed, DUI		3	0	1
1995	3:14	41	speed, DUI		1	2	1
1995	5:11	16	loss of control		2	0	1
1995	13:40	16	ran stop sign		2	5	1
1995	9:40	16	left turn		2	1	1
1995	19:10	13	speed	no striping (temporary tabs)	1	0	1
1995	10:35	16	failure to yield		2	1	1
1995	3:12	16	unsafe lane change		4	5	1
1995	18:22	16	ignored traffic signal		2	1	1
1995	23:34	16	DUI		2	2	1
1995	2:03	16	DUI		3	0	1

year	accident time	1st harmful	officer opinion	other notation	# units	# injurd	# fatal
1996	20:50	16	speed, DUI		3	2	1
1996	23:15	16	speed, inattention		2	1	1
1996	15:13	16	medical incapacity		3	5	1
1996	5:30	32	speed		2	0	1
1996	13:35	16	speed, inattention, ran into stopped traffic		2	2	1
1996	5:53	41	ran stop sign, DUI	no striping	1	0	1
1996	23:00	14	DUI		2	2	1
1996	15:58	37	speed		1	0	1
1996	17:15	16	ignored traffic signal		2	3	1
1996	8:15	40	ran stop sign, DUI	no striping	1	0	1
1996	18:09	37	speed, DUI		1	1	1
1996	11:23	49	cherry picker hit underneath by passing semi		2	0	1
1996	9:15	16	ran red light		2	0	1
1996	17:58	37	speed, DUI		1	0	1

There were 82 fatal accidents with 89 fatalities during the period of 1992-1996. Of those accidents, 24 (29.3%) involved a DUI, and 28 (34.1%) were speed related. The location of the accidents was evenly split with 39 (47.6%) occurring on the Interstate and elsewhere on the State Highway System and 43 (52.4%) occurring on other roadways. Forty-two (51.22%) of the accidents happened during daylight and 40 (48.78%) happened during dusk or darkness.

Many of the accident reports included some comments noting that the accident occurred in a work zone. Most reports stated that the construction or maintenance being conducted was not a factor in the accident. However, as shown in the above table under the "other" column heading, there were 20 accident reports that included comments suggesting that a feature of the work zone itself could have been a contributory factor.

- Two accidents involved work zone personnel - one in which a flagman was backed over by a dump truck, and one in which the officer directing traffic through the work zone was run over by the back end of a turning construction semi. In both accidents, the vehicles and the victims were directly involved with work zone operations. These accidents most likely would not have been prevented by any of the countermeasures mentioned in this report.
- One accident noted that there was possible visual obstruction by a flashing device so that one vehicle traveling on the roadway may not have seen the other vehicle pulling onto the roadway until it was too late to stop.

- One accident noted a low level of illumination, which may have been a temporary condition related to construction activity.
- The remaining 16 (19.5%) accidents noted that there was no striping in the location of the accident. Although these accidents were also noted as being caused by speed and/or DUI, or driver inexperience, the lack of roadway striping combined with those factors could have contributed to the occurrence of the accident

The review and analysis of the fatal accident reports did not clearly identify any common or widespread factors that contribute to incidents occurring in work zones. Rather, it appears that many of these accidents could have occurred anywhere and randomly occurred in the work zone.